

Projectile Motion:

- X- and Y- directions are independent
- No acceleration in the x-direction
- Ignore air resistance
- Object is in free-fall \rightarrow y-direction
- Y-direction acceleration = $a_g = 9.8 \text{ m/s}^2$
down

<u>Variable</u>	<u>Unit</u>
Δx	m
Δy	m
v_i	m/s
v_{ix}	m/s
v_{iy}	m/s
t	s
a_g	m/s^2
v_f	m/s
v_{fx}	m/s
v_{fy}	m/s
θ_i	degrees
θ_f	degrees

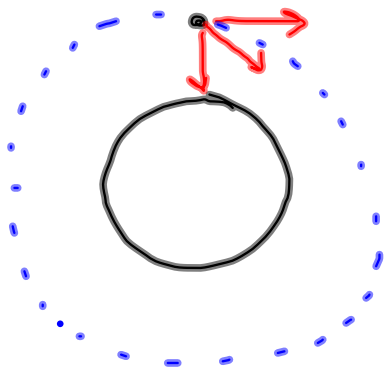
Equations:

$$\Delta x = v_{ix} t$$

$$\Delta y = v_{iy} t + \frac{1}{2} a_y t^2$$

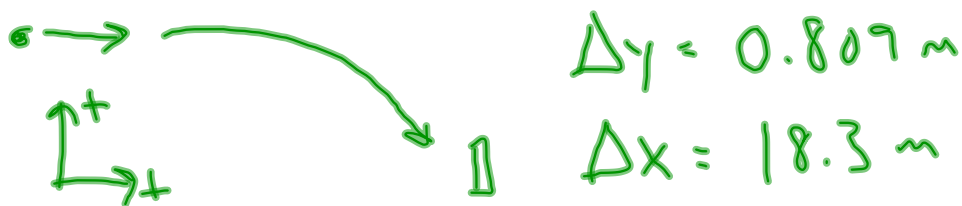
$$v_{fy}^2 = v_{iy}^2 + 2 a_y \Delta y$$

$$v_{fy} = v_{iy} + a_y t$$



Objects in orbit
are constantly
falling freely.

The fastest recorded pitch in Major League Baseball was thrown by Nolan Ryan in 1974. If this pitch were thrown horizontally, the ball would fall 0.809 m by the time it reached home plate, 18.3 m away. How fast was Ryan's pitch?



$$v_{iy} = 0 \text{ m/s} \quad v_{ix} = ? \quad t = ?$$

$$\Delta y = v_{iy} t + \frac{1}{2} a_y t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_y}}$$

$$= 0.406 \text{ s}$$

$$\Delta x = v_{ix} t$$

$$v_{ix} = \frac{\Delta x}{t}$$

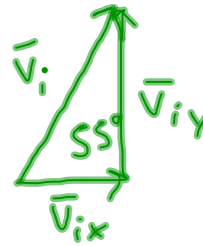
$$= 45.1 \text{ m/s}$$

Projectile Motion Test Review and Practice Problems 1st Block 9.12.11

A shell is fired from the ground with an initial speed of 1.70×10^3 m/s at an initial angle of 55° to the horizontal and returns to the ground. Neglecting air resistance, find

a) the shell's horizontal range.

b) the amount of time the shell is in motion.



$$V_{ix} = V_i \cos(55^\circ) \\ = 975 \text{ m/s}$$

$$V_{iy} = V_i \sin(55^\circ) \\ = 1393 \text{ m/s}$$

$$V_{fy} = -1393 \text{ m/s}$$

$$b) \quad V_{fy} = V_{iy} + a_y t$$

$$t = \frac{V_{fy} - V_{iy}}{a_y} \\ = \frac{-1393 \text{ m/s} - 1393 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

$$= 284 \text{ s}$$

$$a) \quad \Delta x = V_{ix} t$$

$$= (975 \text{ m/s})(284 \text{ s})$$

$$= 2.77 \times 10^5 \text{ m}$$

Projectile Motion Test Review and Practice Problems 1st Block 9.12.11

A person standing at the edge of a seaside cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface.

- a) How long does it take for the stone to fall to the water?
- b) With what speed does it strike the water?